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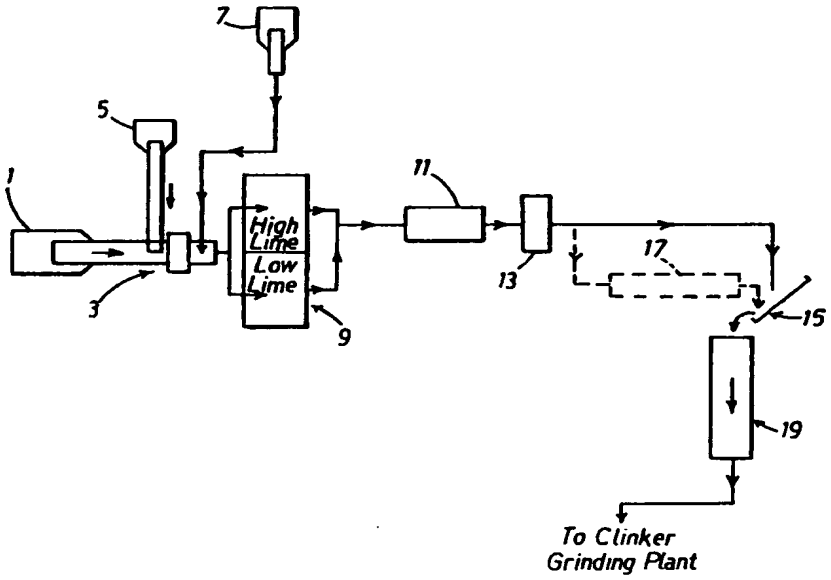
(54) Improvements relating to the manufacture of cement

(57) A process for preparing the raw materials for feeding to a vertical kiln for cement production is described. Such kilns have the disadvantage that the fuel moves counter to the air and combustion gases, and this causes undesirable secondary reactions resulting in the production of harmful carbon-monoxide and the premature burning of the fuel. To combat such problems, the fuel is wet with water and mixed with previously ground raw material so that each fuel particle attains a protective shell of mud.

The wet raw material is first passed through a primary crusher (3) and then mixed with sold fuel. The mix is then passed through a web ball mill (11) and ground to form a slurry. Then the slurry is passed through a filter (13) and/or drier (17) to remove excess water before it is passed to a pelletiser (15) and finally, the vertical kiln (19).



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The drawing(s) originally filed was/were informal and the print here reproduced is taken from a later filed formal copy.
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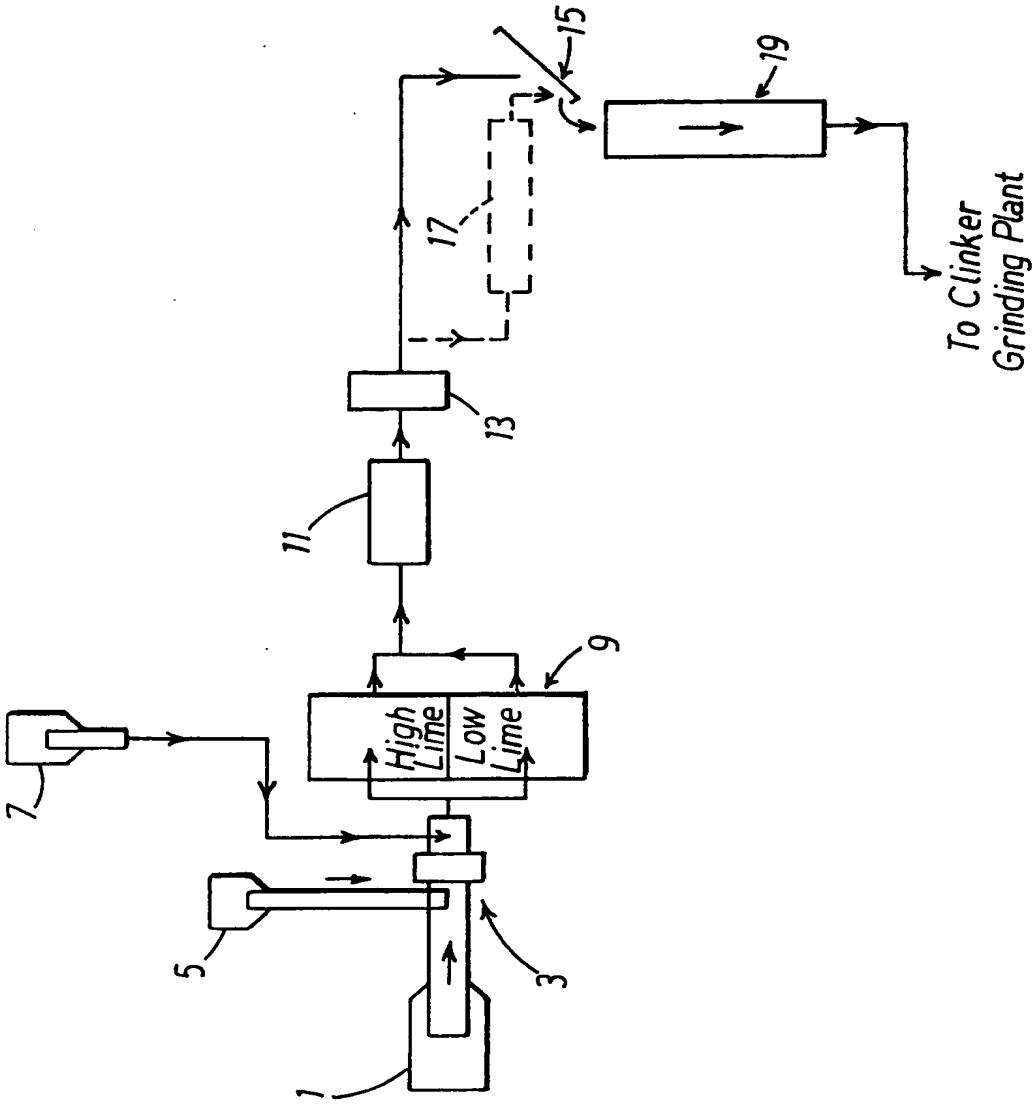
15
19
17
To Clinker
Grinding Plant
13
11
9
High
Lime
Low
Lime
7
5
3
1

SPECIFICATION

Improvements relating to the manufacture of cement

The present invention relates to the manufacture of cement.

More particularly the present invention relates to the manufacture of cement on a relatively small, though economic scale. For all types of cement manufacturing processes the fundamentals remain the same. In the first stage the raw materials—limestone, chalk, marl, clay etc.—are mined, crushed, ground and homogenised to a blend having the required chemical composition and fineness. In the second stage this blend is subjected to heat treatment, to temperatures reaching about 1450°C at which the clinker materials with the desired hydraulic characteristics are formed, and in the third stage the clinker is ground with gypsum to give the finished cement.

Development of cement production led to the construction of large rotary kilns. However, these rotary kilns were only economic for large annual throughputs. To cater for smaller production levels the old vertical kiln process was adopted and modified to more efficiently produce the required grade of cement. However the use of these improved vertical kilns still had one notable shortcoming due to an inherent feature of its design and operation. Whilst in a rotary kiln fuel and air move in the same direction, in a vertical kiln the fuel moves counter to the air and combustion gases, and this causes undesirable secondary reactions. One of the worst of these is the reaction between the upwardly streaming CO_2 gas linked with the premature burning of the fuel particles to CO. Consequently, fluctuations of heat input occurred, giving varying operational conditions resulting in lack of heat for the efficient production of the required clinker. Clinker quality and the amount of dust discharged in the flue gases varied.

To improve the vertical kiln operation a fuel slurry was formed in a wet ball grinding mill. In this mill the fuel is ground and each particle of fuel becomes surrounded by a layer of water which, on subsequent contact with the dry ground raw materials e.g. limestone, clay and/or shale, changes into a 'mud' layer. This layer becomes a hardened 'shell' when the thus formed pellets pass through the preheating zone of the kiln, the shell protecting the fuel particles from premature burning and also preventing the undesirable reaction of the fuel with upwards streaming CO_2 gas produced by the dissociation of the carbonate element in the raw materials further down in the hotter part of the kiln, to give potentially explosive carbon-monoxide. The protection of the 'shells' finishes when the carbonates in the raw material shells dissociates, leaving porous and permeable pellets behind. However, at this stage sufficient air is already available to ignite the fuel particles and burn them to complete combustion.

In the above described process the raw materials are dry ground using a hot air swept mill. This process is well suited to operation in relatively dry climates where the raw materials can be excavated in a relatively dry state. However, if in a given site location the average rainfall is appreciable, as in the United Kingdom, the raw materials as excavated from a quarry can have a significant moisture content e.g. chalk in the U.K. can have a moisture content as high as 25%. Such conditions drastically reduce the output of the roller mill and increase wear and tear. Further the filters tend to become quickly blocked. Clearly therefore the above described dry preparation process is not readily applicable to operation in areas where rainfall is appreciable.

The aim of the present invention is to provide a process for use in the manufacture of cement, which process can prepare relatively wet raw materials for use in a vertical kiln, without any detrimental affect on the performance of the apparatus.

According to the present invention there is provided a process for preparing the raw materials for feeding to a vertical kiln for cement production, the said process comprising the steps of mixing the raw materials and solid fuel together and passing the mix to a mill wherein the mix is combined with water and ground to a slurry, the slurry being subsequently passed to a filter where some of the water is removed prior to passing through the pelletiser to the vertical kiln.

In a preferred embodiment of the present invention wherein the raw materials are excavated from a relatively wet area, 'high' and 'low' lime blends from a primary crusher e.g. a movable breaker plate hammer mill, are proportioned together with the solid fuel and are fed to a wet ball mill to grind the mix to a slurry with approximately 42% water content. The excavated high lime chalk or limestone is still dry enough to carry the wetter clay or shale through the hammer mill and permit smooth discharge of the lime blends from appropriately designed storage bins into the wet ball mill. A further 9% or so dry fuel added to the mix i.e. raw material blend, will help the smooth discharge from these bins. The slurry is then preferably passed from the wet ball mill into a Dorr Oliver disc type filter in which at least 25% of the water is removed. With some raw materials sufficient water can be removed by the disc filter so that the disc filter product can be fed direct to the pelletiser. However, in certain cases it is necessary to pass the disc filter product through a rotary drier to remove additional moisture and thereby attain a consistency suitable for pelletising.

Thus relatively wet materials can be prepared efficiently by virtue of the present invention, the fuel particles obtaining a protective shell as per the previously described dry preparation method, the shell protecting the fuel particles during passage through the preheating zone of the vertical kiln.

The process of the present invention is simple and requires less plant than the similar dry preparation method. Thus the capital costs and production costs of the present invention are less. Further the distribution of the fuel in the pellets is more uniform than in the dry preparation method and this leads to more even burning and a more uniform product.

Whilst the present invention i.e. wet preparation method, is particularly suitable for areas where wettish raw materials are found e.g. United Kingdom, it can of course be equally well used in drier areas because much of the water used in the process can be recirculated.

The present invention will now be further described, by way of example, with reference to the accompanying drawing which schematically illustrates a preferred plant/flow diagram arrangement according to the present invention.

The preferred embodiment of the present invention illustrated in the accompanying drawings provides for the wet limestone or chalk, as excavated, to be fed from a hopper 1 into a hammer mill 3 where the limestone or chalk is crushed. Clay or shale is added from hopper 5, and crushed with the limestone or chalk; solid fuel being added from hopper 7. The solid fuel and the raw materials are then fed in the required proportions into suitable designed storage bins 9, the high lime chalk or limestone being dry enough to carry the wetter clay or shale through the hammer mill 3 and permit smooth discharge from the storage bins 9 into a wet ball mill 11. Easier discharge from the bins 9 is also helped by the, 9% or so of dry fuel added to the raw material blends before they are fed into the storage bins 9. In the wet ball mill 11, the fuel and raw materials are ground into a slurry with approximately 42% water content. The slurry is then passed to a Dorr Oliver disc type filter 13 in which at least 25% of the water is removed. With certain wet raw materials sufficient water can be removed by the disc filter 13 so that the disc filter product can be fed direct to the pelletiser 15. However in certain cases it is necessary to pass the disc filter product through a rotary drier 17 (shown in dashed lines) to remove additional moisture and thereby obtain a consistency suitable for pelletising. The fuel particles are thus provided with a shell of raw material as in the dry preparation method, the shells protecting the fuel particles from premature burning when passing through the preheating zone of the vertical kiln 19 whereby clinker is produced.

The present invention thus provides a process for preparing wet raw materials for use in cement production, which raw materials would have been completely unsuitable for use in the previously described 'dry preparation method'. Whereas the 'dry preparation method' is only really suited to drier climates and the raw materials obtained in such areas, the present invention can be used in wet or dry areas, dry area usage being especially feasible as much of the water used in the process can be recirculated.

Additionally the process of the present invention is simpler than the dry preparation method and requires less plant. Thus capital costs and production costs are relatively smaller. Further due to the formation of a slurry the distribution of the fuel particles in the pellets is more uniform than in the dry preparation method, leading to more even burning and therefore a more uniform product.

CLAIMS

1. A process for preparing the raw materials for feeding to a vertical kiln for cement production, the said process comprising the steps of mixing the raw materials and solid fuel together and passing the mix to a mill wherein the mix is combined with water and ground to a slurry, the slurry subsequently passed to a filter where some of the water is removed prior to passing through a pelletiser to the vertical kiln.

2. A process as claimed in claim 1, in which calcium carbonate blends from a primary crusher is proportioned together with the solid fuel and fed to the wet ball mill to grind the mix to a slurry with approximately 42% by weight water content.

3. A process as claimed in claim 2, in which a further 9% or more, by weight, dry fuel is added to the mix.

4. A process as claimed in claim 1, 2 or 3, in which the slurry is padded from the wet ball mill to a Dorr Oliver disc type filter in which at least 25% by weight of the water is removed.

5. A process as claimed in claim 4, in which the slurry is passed from the filter through a rotary drier.

6. A process for preparing the raw materials for feeding to a vertical kiln for cement production, substantially as hereinbefore described with reference to the accompanying drawings.

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ABSTRACT:

A process for preparing the raw materials for

feeding to a vertical kiln for cement production is described. Such kilns have the disadvantage that the fuel moves counter to the air and combustion gases, and this causes undesirable secondary reactions resulting in the production of harmful carbon- monoxide and the premature burning of the fuel. To combat such problems, the fuel is wet with water and mixed with previously ground raw material so that each fuel particle attains a protective shell of mud.

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